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VARIATION OF *PEROMYSCUS MANICULATUS* IN PARTS OF WESTERN WASHINGTON AND ADJACENT OREGON

By Lee R. Dice

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INTRODUCTION

The Puget Sound region of Washington is of special interest to the student of evolution because in that region two subspecies of the same species of deermouse are reported to occur together over a wide area. *Peromyscus maniculatus oreas* alone occupies the higher mountains, but in the lowlands it occurs at some places together with *P. m. austerus*. Such an unusual relationship between subspecies of the same species deserves investigation.

Another interesting feature of the biogeography of the Puget Sound region is the occurrence of distinct races of deermice on certain of the islands in the Sound. It may be presumed that geographic isolation has been an important factor in the origin of these island races, but no study has previously been made of the hereditary variability of the mice on the several islands.

The Columbia River, which for a considerable distance forms the boundary between Washington and Oregon, is a major barrier to the movements of these deermice. On the southern side of the river, in western Oregon, is found the subspecies *Peromyscus maniculatus rubidus,* while north of the river in western Washington the two subspecies *oreas* and *austerus* occur.

Another barrier to the movements of these deermice is formed by the Cascade Mountains. Immediately east of these mountains, on both sides of the Columbia River, the subspecies *gambelii* is said to occur, replacing there the more western subspecies, *oreas, austerus,* and *rubidus* (Osgood, 1909).

In this paper I shall describe the variability in the characters of *Peromyscus maniculatus* in stocks of these mice collected at several localities in western Washington and adjacent Oregon. Comparisons will be made between populations separated by various kinds of physical and climatic barriers. Although the number of stocks described is too few to give a complete account of the variability of the local populations of deermice, yet it will be possible to draw some tentative conclusions about the relationships of some of the races which live in this region.

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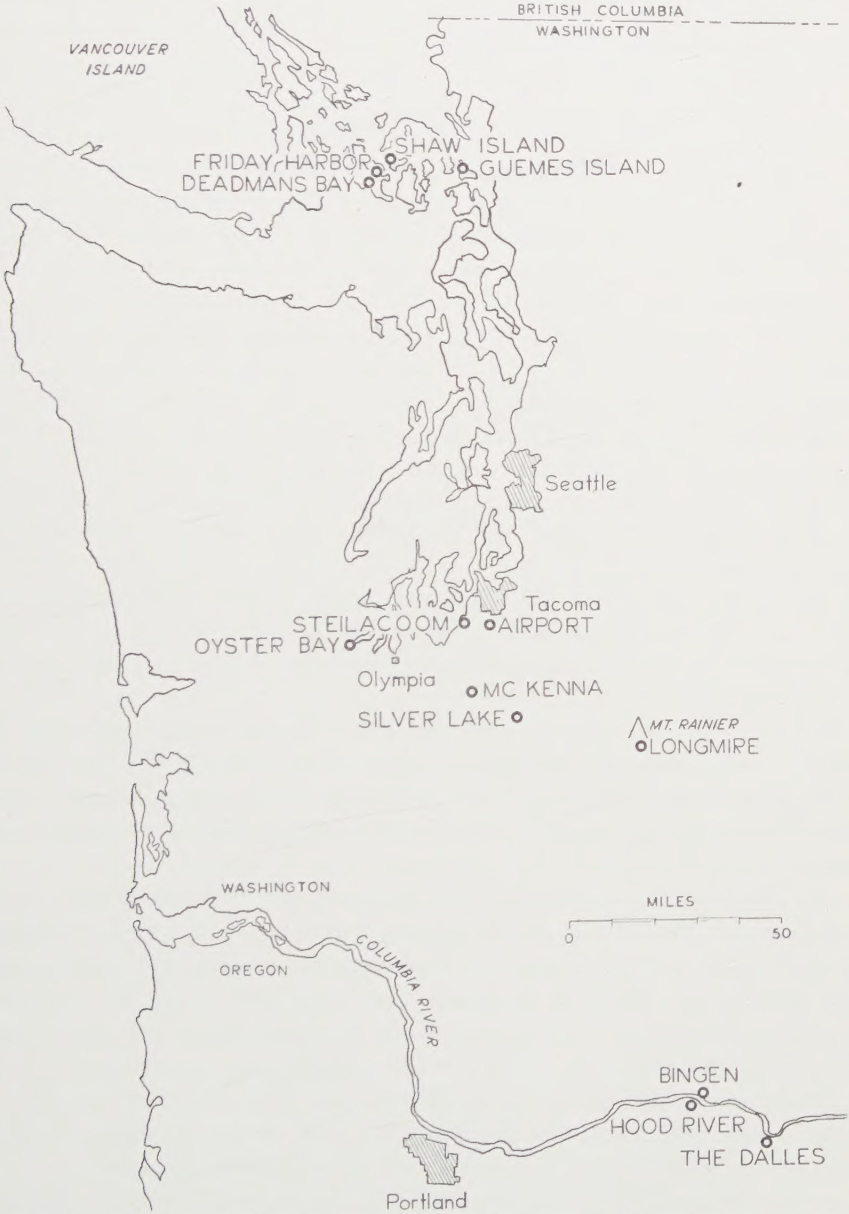
COLLECTING STATIONS

The breeding stocks of mice were received at the Laboratory over a considerable period of years. They were obtained from the following localities (Map 1):

Airport. One-half mile east of the Tacoma Airport, Parkland, Pierce County, Washington. Eight males and ten females were trapped by H. J. Leraas in 1937 in a wooded area near a bog.

Bingen. Four miles east of Bingen, Klickitat County, Washington. Six males and four female mice were trapped in 1940 by Lee R. Dice and his family in grass and among shrubs on rocky slopes and bluffs along the north side of the Columbia River.

Chinook Pass. Six miles east of Chinook Pass, Yakima County, Washington, elevation 4,500 feet, in the Cascade Mountains. A number of these mice were taken by H. J. Leraas in 1939 in fairly dense second-growth forest of lodgepole pine, tamarack, white pine, spruce, and a few Douglas fir, at the Lodgepole Forest Camp in the Snoqualmie National Forest.



MAP 1. Sketch map of part of western Washington and adjacent Oregon, showing most of the collecting localities. The Paradise Park locality is on Mount Rainier about seven miles northeast of the Longmire locality. The Chinook Pass locality lies about twenty-five miles northeast of the Longmire locality.

The stock failed to breed successfully and ultimately eleven of the field-caught animals were prepared as specimens.

Dalles. Five miles east of the city of The Dalles, Wasco County, Oregon. Eight males and five female mice were trapped by Lee R. Dice and his family in 1940 on grassy slopes, mostly near rock bluffs, along the south side of the Columbia River.

Deadman's Bay. Deadman's Bay near Lime Kiln Light, San Juan Island, about ten miles southeast of Friday Harbor, in Puget Sound, Washington. Six males and five female mice were trapped by Arthur Svihla in 1936 in typical coastal forest about one hundred feet above sea level.

Friday Harbor. From Friday Harbor, San Juan Island, in Puget Sound, Washington. Eleven males and five females were captured by Julius Haverson in 1932 in a burned area. They were received by us through the kindness of J. C. Cross. These animals were sent to us some years earlier than most of the other stocks and most were reared in a different building from the stocks later received. The food and other factors in the laboratory habitat, however, were very similar for all the stocks. The specimens of these animals were all prepared in the spring of the year and their pelage colors are therefore comparable with those of the stocks described in previous papers, but their ages when prepared as specimens were not very uniform.

Guemes Island. From the northern part of Guemes Island, near Clark Point and opposite Jack Island, in Puget Sound, Washington. Three males and three females were captured by Arthur Svihla in 1936 in a forested habitat.

Hood River. Seven miles west of Hood River, Hood River County, Oregon. Twelve males and nine females were trapped by Lee R. Dice in 1940 in brush and among small second-growth trees in a small side valley off the Columbia River gorge. The most abundant trees were small Douglas firs.

Longmire. Two miles west of Longmire, Mount Rainier National Park, Washington. Fourteen males and eleven females were trapped in 1940 by Lee R. Dice in heavy coastal forest dominated by Douglas fir, western hemlock, and red fir. Through a mistake which occurred during the war years no animals of this stock were prepared as specimens when one year of age. Of the two-year age class, thirty-five individuals were preserved.

McKenna. One mile east of McKenna and about fifteen miles south of Parkland, in Pierce County, Washington. Ten mice were collected by H. J. Leraas in 1936 in second-growth forest, mostly of Douglas fir.

Oyster Bay. Oyster Bay, on Puget Sound, ten miles west of Olympia, Thurston County, Washington. Nine males and six females were taken by Harold J. Leraas in 1940 in a second-growth forest of Douglas fir, madroña, and a few alder.

Paradise Park. Paradise Park, Mount Rainier National Park, Pierce County, Washington, at an elevation of about 5,000 feet, just below timberline. Five males and three females were secured by Lee R. Dice with the help of the park rangers in 1940. The species was rare here in alpine fir forest and in edificarian habitat about buildings. The animals failed to breed well in captivity and produced only a small laboratory-bred stock. Five of the field-caught animals were prepared as specimens.

Port Angeles. Along the Elwha River, twelve miles south of Port Angeles, Clallam County, Washington. Twenty-nine mice were trapped in woods along the river bottom in 1931 by Arthur and Ruth Svihla. This stock failed to breed successfully. Twenty-three of the field-caught animals were later prepared as specimens.

Shaw Island. Squaw Bay, on Shaw Island, in Puget Sound, Washington. Four males and four females were taken by Arthur and Ruth Svihla in 1936 in typical coastal forest.

Silver Lake. On the western side of Silver Lake, five miles west of Eatonville, in Pierce County, Washington. Nine males and two female mice were trapped in 1940 by Lee R. Dice and his family in second-growth coastal forest dominated by Douglas fir.

Steilacoom. Two and one-half miles south of Steilacoom, Pierce County, Washington. Nine males and seven females were taken by H. J. Leraas in 1940 in an area covered by second-growth shrubs and Douglas fir.

METHODS OF STUDY

The methods of study used are practically the same as in my previous investigations of variation in *Peromyscus* (Dice, 1932*a*). The animals listed in the tables as ''field-caught'' are those taken in nature and then kept under uniform conditions in the laboratory for varying lengths of time, mostly one year or more, before being prepared as specimens. The animals of the ''one-year'' age class were born in the laboratory and prepared as specimens when they were approximately one year of age. A special attempt has been made to have all the specimens comparable in age. Very few of the animals varied more than a week from the age of fifty-two weeks at the time when they were prepared as specimens. The mice of the ''two-year'' age class were mostly close to 104 weeks of age at the time they were prepared as specimens.

The season of the year when the mice reached the proper age for preparation as specimens varied, except for the Friday Harbor stock, all of which were prepared in the spring. Most of these specimens, therefore, were not, as those recorded in previous studies, all prepared at the same season. For this reason the tint-photometer readings may be presumed to be more variable and not exactly comparable with those of my earlier studies.

The statistical comparisons between means have been made by the method of Dice and Leraas (1936). Any difference between two means which is greater than two times the sum of the standard errors of the two respective means is considered to be significant. In general, such a difference will have a *t* value close to 2.7.

My own acquaintance with the Puget Sound region covers many years. The stocks of mice on which this study is based were collected in part by me and my family during a period of intensive study extending from June 28 to July 31, 1940. Numerous other breeding stocks from the region, however, had been previously received from scientific associates of the Laboratory. Several of these breeding stocks failed to produce a sufficient number of offspring to serve as a basis for statistical treatment. For these we have, therefore, only the measurements of the field-caught animals. For several of the stocks, measurements are available of series of two-year-old as well as one-year-old animals, giving an opportunity to measure the amount of growth between the ages of one and two years. For the stock from Longmire, measurements are available for a series of two-year-old animals, but not for the one-year class. The measurements of the two sexes have been combined in all tables and comparisons. Previous studies of the species have discovered only slight sex differences, except in foot length. Even in foot length the difference between males and females is not sufficiently great to justify separating the sexes when making comparisons between the several stocks.

The descriptions and statistical treatments apply only to the laboratory-reared stocks, which undoubtedly do not fully represent the wild ancestral populations.

VARIATION DUE TO AGE

Measurements are available for both the one-year and two-year age classes in four stocks (Table I). More than sixty individuals are included in the one-year class of each of the four stocks. In the two-year class there are more than fifty individuals from Silver Lake and from Steilacoom, thirty-two from The Dalles, but only fifteen from Shaw Island.

These stocks are of special value for determining the amount of growth of these mice in the interval between one and two years of age, because most of the laboratory-bred mice when killed and measured closely approximated either fifty-two or 104 weeks of age. In the Dalles and Silver Lake stocks none of the mice deviated more than a week from being either fifty-two or 104 weeks of age when prepared as specimens. This was true also for the Steilacoom one-year age class, but the two-year class of that stock varied from ninety to 106 weeks of age. The Shaw Island mice were more variable, and the one-year age class ranged from forty to seventy-one weeks and the two-year class from eighty-four to 104 weeks of age.

The two-year-old mice average larger than the one-year mice in all measurements except for three in the Dalles stock. Exceptions in the Dalles stock are the measurements of tail length, foot length, and ear length, which average smaller in the two-year than in the one-year age class. These differences are not significant, except possibly for foot length, where the difference is 0.203 ± .102 mm.

In body length the two-year age class significantly exceeds the one-year class in three of the stocks, but for the Dalles stock the difference (1.51 ± .95 mm.) is not significant. In tail length the amount of growth between one and two years of age is significant for the Shaw Island and Steilacoom stocks, but not for the Silver Lake stock, while the Dalles mice of the two-year class average smaller than those of the one-year class. In foot length the two-year-old mice of the Steilacoom stock exceed the one-year mice by an amount (0.152 ± .072 mm.) which is barely significant, while there is no significant amount of growth in the other stocks. In fact, the two-year old mice from the Dalles stock average smaller in foot length than the one-year mice. In ear length there is a significant amount of growth between one and two years of age in the Silver Lake and Steilacoom stocks, but not in the other two stocks. In all the measurements of femur and skull the two-year-old mice average significantly larger than the one-year mice,

TABLE I

EFFECT OF AGE ON MEASUREMENTS OF *Peromyscus maniculatus*
Differences in means and standard errors of the differences.
Two-year age class minus one-year age class.

Character	Stock			
	Dalles	Shaw Island	Silver Lake	Steilacoom
Dimensions, in mm.				
Body length	1.51 ± .95	3.00 ± .94	2.57 ± .70	3.53 ± .59
Tail length	− .26 ± .93	3.72 ± .66	.69 ± 1.07	3.30 ± .90
Foot length	− .203 ± .102	.218 ± .134	.075 ± .102	.152 ± .072
Ear length	− .005 ± .106	.256 ± .150	.347 ± .136	.695 ± .126
Femur length	.743 ± .127	.548 ± .192	.498 ± .108	.837 ± .125
Mandibular length	.140 ± .074	.547 ± .123	.659 ± .085	.516 ± .079
Condyle-premaxilla	.128 ± .114	.679 ± .181	.370 ± .122	.701 ± .083
Condyle-zygoma	.256 ± .085	.307 ± .105	.385 ± .082	.426 ± .065
Bullar width	.218 ± .050	.153 ± .047	.114 ± .052	.178 ± .045
Tint-photometer readings				
Dorsal stripe				
Red	.28 ± .21	−.40 ± .15	.49 ± .16	−.43 ± .11
Green	.28 ± .16	−.09 ± .13	.33 ± .13	−.32 ± .11
Blue-violet	.80 ± .11	−.08 ± .14	.30 ± .16	−.28 ± .09
Side stripe				
Red	.16 ± .35	.17 ± .31	.37 ± .26	.91 ± .20
Green	.28 ± .25	.23 ± .32	.32 ± .24	1.23 ± .32
Blue-violet	.10 ± .24	−.14 ± .24	.14 ± .19	.40 ± .16

except in the Dalles stock for mandibular length (difference = 0.140 ± .074 mm.) and condylo-premaxillary skull length (difference = 0.128 ± .114).

Although there is evidence for growth between one year and two years of age in many of the dimensions of these deermice, the several stocks are not fully consistent with one another in showing this trend. In tail length, for instance, the two-year-old mice of the Shaw Island and Steilacoom stocks exceed the one-year mice by amounts well over 3.0 mm., but the other two stocks for which the age classes can be compared show no significant differences between these two age classes. Only in the Steilacoom stock are the two-year mice significantly larger in every measurement than the one-year mice. At the other extreme, the two-year mice of the Dalles stock are significantly larger than the one-year mice only in femur length, condylo-zygomatic distance, and bullar width of skull, and the one-year mice average the larger in tail length, foot length, and ear length. These inconsistencies between the several stocks in the relationships between the one-year and two-year classes are almost certainly due to random variation within each stock among the individuals measured.

I conclude then that some growth takes place in most of the dimensions of the body and skeleton of these mice between their first and second years of age. Only in foot length is a fairly consistent growth trend between these ages lacking. The amount of growth in most of their dimensions after these mice are one year of age, however, is not very great.

No evidence is given by the data here presented for any difference in pelage color between the mice of the one-year and two-year age classes. For some colors the one-year mice average the higher in readings, while for other colors the two-year mice average the higher. For about one-third of the comparative color readings of the two age classes the differences are significant. In view of the inconsistency of the trends, no difference in pelage color based on age seems to occur in these mice.

EFFECTS OF CAPTIVITY

For five of these stocks, those from Airport, Friday Harbor, Hood River, Longmire, and Paradise Park, there are available measurements of small series of field-caught animals which had been kept in captivity for one or two years before being prepared as specimens. These measurements can be compared with those of the laboratory-bred mice which are their descendants (Table II).

In general, the field-caught mice average somewhat larger in their measurements than do the one-year-old, laboratory-bred mice of the same stocks. Such a difference would be expected because of the greater age of the field-caught animals, all of whom had been kept in the laboratory for one year or more and therefore averaged considerably over a year in age when they were prepared as specimens. Compared to the two-year-old, laboratory-bred mice the field-caught mice average larger in some measurments and smaller in others. On account of the few field-caught animals available for measurement, statistical comparisons between them and the laboratory-bred animals are not convincing. At least there is no good evidence of any consistent effect of captivity on the dimensions of these mice.

Nor is there any evidence for a difference in pelage color between the mice caught in the field and then kept in the laboratory for a year or more and those bred in the laboratory and reared there to the age of one year. For some color comparisons the laboratory-bred mice average higher in readings, while for other colors the field-caught animals have the higher means. In only a few of the color comparisons are the differences of statistical significance.

So far as these data can be depended upon, therefore, no difference in body dimensions or in pelage color is demonstrated between the field-caught and the laboratory-bred mice. The evidence indicates that being born in the laboratory has had no significant effect on the characters of the animals. It is possible, of course, that life in the laboratory has affected all the field-caught and laboratory-bred animals in some similar manner.

LOCAL VARIATION

Local variation which has no apparent relationship to physical or to climatic barriers is exhibited by a number of these stocks of deermice.

The Friday Harbor and Deadman's Bay stocks differ in several of their measurements, although the collecting localities are only about ten miles apart on the same island. The Deadman's Bay mice of the one-year class significantly exceed those from Friday Harbor in foot length, ear length, length of mandible, condylo-premaxillary skull length, and condylo-zygomatic distance (Table III). The Deadman's Bay mice are also darker in pelage than are those from Friday Harbor, as shown by their significantly higher tint-photometer readings for both dorsal and side stripes for all color screens (Table IV). The differences in color readings between the two stocks are appreciable. For example, in readings for red reflected from the side stripe the Friday Harbor one-year-old mice exceed those from Deadman's Bay by 1.87± .18 units.

From the lowland region around the southern end of Puget Sound there are available five stocks, all taken in much the same kind of habitat. Of these the Airport collecting locality is only about fifteen miles from the McKenna locality. These two localities are separated by an area of open country mostly with some scattered oak scrub (letter from H. J. Leraas). The Silver Lake locality is about ten miles east and a little south of the McKenna station. The Steilacoom locality is, as measured on the map, less than ten miles from the Airport station. The collecting locality at

TABLE II

Effect of Captivity on Measurements of *Peromyscus maniculatus*

Differences in means and standard errors of the differences.

Character	Stock				
	Field-caught Minus 1-year Class			Field-caught Minus 2-year Class	
	Airport	Friday Harbor	Hood River	Longmire	Paradise Park
Dimensions, in mm.					
Body length	5.42 ± 1.11	2.49 ± 1.17	.83 ± 1.23	− 2.68 ± .96	4.27 ± 1.92
Tail length	3.82 ± 1.58	6.31 ± 1.99	− .68 ± 1.88	2.15 ± 1.76	5.65 ± 2.41
Foot length	− .441 ± .144	.158 ± .183	− .690 ± .158	− 1.026 ± .234	.400 ± .259
Ear length	.903 ± .235	.659 ± .142	− .284 ± .261	− .482 ± .283	.540 ± .414
Femur length	.599 ± .261	.684 ± .196	.327 ± .182	− .632 ± .220	.583 ± .125
Mandibular length	.172 ± .140	.009 ± .120	− .297 ± .111	− .235 ± .168	.050 ± .202
Condyle-premaxilla	.358 ± .184	.235 ± .164	− 1.556 ± .206	− .589 ± .244	....
Condyle-zygoma	.218 ± .178	.282 ± .101	− .136 ± .129	− .151 ± .168	− .133 ± .240
Bullar width	.147 ± .072	.026 ± .085	.294 ± .067	− .162 ± .061	.417 ± .088
Tint-photometer readings					
Dorsal stripe					
Red	− .96 ± .16	− .17 ± .20	.13 ± .31	− .01 ± .25	− .10 ± .28
Green	− .45 ± .15	− .23 ± .14	.09 ± .22	− .42 ± .17	− .03 ± .32
Blue-violet	− .13 ± .16	− .16 ± .19	.18 ± .14	− .37 ± .17	− .17 ± .20
Side stripe					
Red	− .98 ± .41	.25 ± .40	− .16 ± .49	.31 ± .55	− .46 ± 1.01
Green	.07 ± .35	− .17 ± .31	− .11 ± .36	− .13 ± .46	− .73 ± .64
Blue-violet	.86 ± .26	− .29 ± .19	.00 ± .20	− .34 ± .45	− .46 ± .50

Oyster Bay is a little farther away, being about twenty miles northwest of the McKenna locality. These five collecting localities, therefore, lie within an area about forty-five miles in greatest diameter.

Notwithstanding the small geographic distances that separate their stations of origin, these five stocks of *austerus* exhibit important differences in their body dimensions and in their pelage color. The Airport mice when alive gave the impression of being much more delicate in structure than were the others of this group of stocks, especially those from the McKenna locality only fifteen miles away. The measurements of the one-year-old mice from Airport average significantly smaller than those of the same age class in any of the other four stocks of this group for body length, length of mandible, condylo-premaxillary skull length, and condylo-zygomatic distance. In tail length the Airport mice average significantly shorter than do the Oyster Bay and Silver Lake mice. In foot length the Airport mice significantly exceed the Silver Lake mice, but are themselves significantly exceeded by the Oyster Bay mice. In ear length and femur length the Airport mice average significantly shorter than all the others, except the stock from Silver Lake. In bullar width of skull the Airport mice are significantly exceeded by both the McKenna and Steilacoom mice. Some of the differences in measurements between others of these stocks of mice are also significant, though none of the other stocks are so distinctive in their dimensions as the one from Airport.

Some of the differences in measurements between these several local stocks are of considerable magnitude. For example, in ear length the Deadman's Bay mice exceed those from Friday Harbor by an average of 0.856 ± .100 mm. In body length the Airport one-year-old mice average 4.83 ± .86 mm. shorter than those from McKenna and 5.88 ± .81 mm. shorter than those from Oyster Bay. Likewise, in tail length the Steilacoom mice average 5.06 ± 1.03 mm. shorter than those from Silver Lake and 7.09 ± .84 mm. shorter than those from Oyster Bay.

In pelage color it is the McKenna stock which is most distinctive among the five *austerus* stocks. In every color comparison of both the dorsal and side stripes the McKenna stock averages significantly the lower in tint-photometer readings, indicating its darker color. The Airport mice average higher than the remaining three *austerus* stocks in readings for dorsal-stripe red and side-stripe red, but not for green or blue. This indicates a slightly more buffy hue than the others have. The Silver Lake mice average significantly higher in side-stripe red readings than do those either from Oyster Bay or from Steilacoom. In the readings for dorsal-stripe red the McKenna mice average 0.65 ± .13 units less than those from Silver Lake and 1.15 ± .13 units less than those from the Tacoma airport.

It is, therefore, demonstrated that stocks of these Puget Sound deer-mice originating from collecting localities only a few miles apart and not

TABLE III

Measurements of *Peromyscus maniculatus* from Western Washington and Adjacent Oregon

Means, standard errors, and standard deviations (in parentheses), both sexes, in millimeters.

Stock	Class	Number	Number of Parents	Mean Age (Weeks)	Body Length	Tail Length	Foot Length	Ear from Notch
Airport	Field	15	....	....	94.13 ± 0.84 (3.25)	85.80 ± 1.14 (4.41)	19.873 ± .113 (.437)	18.413 ± .213 (.827)
Airport	1 yr.	42	6	51	88.71 ± .73 (4.72)	81.98 ± 1.10 (6.95)	20.314 ± .089 (.572)	17.510 ± .099 (.647)
McKenna	1 yr.	63	4	54	93.54 ± .46 (3.67)	82.18 ± .59 (4.56)	20.214 ± .076 (.600)	18.208 ± .079 (.621)
Shaw Island	1 yr.	87	6	51	100.33 ± .44 (4.13)	83.21 ± .55 (5.13)	22.322 ± .068 (.631)	19.464 ± .073 (.677)
Shaw Island	2 yr.	15	5	92	103.33 ± .83 (3.23)	86.93 ± 1.37 (5.29)	22.540 ± .116 (.449)	19.720 ± .131 (.510)
Steilacoom	1 yr.	62	8	52	92.02 ± .45 (3.54)	80.61 ± .68 (5.30)	20.500 ± .055 (.437)	18.307 ± .083 (.657)
Steilacoom	2 yr.	67	6	103	95.55 ± .38 (3.10)	83.91 ± .59 (4.80)	20.652 ± .047 (.382)	19.002 ± .095 (.775)
Bingen	1 yr.	103	9	52	95.99 ± .32 (3.20)	76.43 ± .44 (4.51)	20.806 ± .046 (.463)	18.012 ± .062 (.620)
Dalles	1 yr.	99	7	53	96.52 ± .40 (4.00)	75.94 ± .38 (3.81)	20.328 ± .049 (.486)	19.063 ± .061 (.607)
Dalles	2 yr.	32	3	104	98.03 ± .86 (4.85)	75.68 ± .85 (4.73)	20.125 ± .090 (.509)	19.068 ± .087 (.485)
Deadman's Bay	1 yr.	121	10	57	99.75 ± .34 (3.77)	77.24 ± .47 (5.03)	21.966 ± .052 (.569)	19.677 ± .069 (.762)
Friday Harbor	Field	15	....	....	102.33 ± 1.04 (4.02)	82.91 ± 1.94 (6.44)	21.853 ± .165 (.637)	19.480 ± .122 (.471)
Friday Harbor	1 yr.	75	11	53	99.84 ± .54 (4.70)	76.60 ± .47 (4.06)	21.695 ± .079 (.687)	18.821 ± .073 (.633)
Chinook Pass	Field	11	....	....	102.82 ± 1.18 (3.91)	99.27 ± 3.62 (12.01)	22.273 ± 266 (.881)	19.582 ± .289 (.958)
Guemes Island	1 yr.	74	4	53	106.01 ± .40 (3.47)	88.68 ± .57 (4.90)	22.431 ± .071 (.610)	19.924 ± .067 (.576)
Longmire	Field	11	....	....	99.73 ± .87 (2.90)	114.60 ± 1.61 (5.10)	22.900 ± .211 (.700)	19.491 ± .253 (.839)
Longmire	2 yr.	35	6	109	102.41 ± .67 (3.92)	112.45 ± .70 (3.90)	23.926 ± .101 (.597)	19.973 ± .128 (.733)
Oyster Bay	1 yr.	94	9	52	94.59 ± .35 (3.43)	87.70 ± .50 (4.85)	20.734 ± .062 (.605)	18.679 ± .078 (.751)
Paradise Park	2 yr.	6	2	104	101.33 ± 1.89 (4.63)	107.75 ± 1.60 (3.20)	23.200 ± .158 (.387)	19.300 ± .185 (.415)
Paradise Park	Field	5	....	....	105.60 ± 1.12 (2.50)	113.40 ± 1.80 (4.03)	23.600 ± .206 (.460)	19.840 ± .371 (.830)
Port Angeles	Field	23	....	....	95.57 ± .70 (3.34)	98.95 ± 2.50 (11.185)	21.741 ± .274 (1.284)	19.243 ± .157 (.717)
Silver Lake	1 yr.	67	8	52	94.09 ± .48 (4.00)	85.67 ± .78 (6.36)	19.967 ± .071 (.587)	17.759 ± .093 (.757)
Silver Lake	2 yr.	51	8	104	96.66 ± .52 (3.78)	86.36 ± .73 (5.35)	20.042 ± .074 (.542)	18.106 ± .099 (.691)
Hood River	Field	17	....	....	97.71 ± 1.16 (4.77)	87.00 ± 1.82 (7.49)	20.588 ± .146 (.600)	18.582 ± .248 (1.02)
Hood River	1 yr.	84	12	52	96.88 ± .41 (3.78)	87.68 ± .48 (4.35)	21.278 ± .061 (.558)	18.866 ± .080 (.731)

Stock	Class	Femur	Mandible	Condyle Premaxilla	Condyle Zygoma	Bullar Width
Airport	Field	15.775 ± .209 (.724)	15.485 ± .124 (.448)	23.831 ± .139 (.502)	16.908 ± .158 (.571)	10.692 ± .065 (.235)
Airport	1 yr.	15.176 ± .157 (.954)	15.313 ± .064 (.401)	23.473 ± .121 (.766)	16.690 ± .081 (.512)	10.545 ± .032 (.204)
McKenna	1 yr.	15.961 ± .100 (.784)	15.867 ± .056 (.443)	24.244 ± .085 (.670)	17.191 ± .055 (.437)	10.719 ± .035 (.279)
Shaw Island	1 yr.	16.744 ± .079 (.728)	16.571 ± .038 (.359)	25.151 ± .062 (.579)	18.013 ± .042 (.395)	11.087 ± .026 (.245)
Shaw Island	2 yr.	17.292 ± .175 (.632)	17.121 ± .117 (.436)	26.133 ± .170 (.659)	18.320 ± .097 (.376)	11.240 ± .039 (.150)
Steilacoom	1 yr.	15.683 ± .087 (.661)	15.667 ± .056 (.429)	24.210 ± .065 (.506)	17.107 ± .049 (.380)	10.698 ± .035 (.275)
Steilacoom	2 yr.	16.520 ± .090 (.722)	16.183 ± .056 (.448)	24.911 ± .052 (.425)	17.533 ± .042 (.339)	10.876 ± .029 (.234)
Bingen	1 yr.	15.787 ± .054 (.542)	16.267 ± .037 (.372)	25.164 ± .061 (.598)	17.361 ± .040 (.400)	10.876 ± .023 (.231)
Dalles	1 yr.	16.087 ± .064 (.633)	16.025 ± .035 (.337)	24.559 ± .067 (.664)	17.225 ± .042 (.409)	10.714 ± .025 (.243)
Dalles	2 yr.	16.830 ± .110 (.693)	16.165 ± .065 (.361)	24.687 ± .093 (.519)	17.481 ± .074 (.413)	10.932 ± .044 (.246)
Friday Harbor	Field	17.277 ± .174 (.629)	16.729 ± .106 (.398)	25.477 ± .147 (.530)	18.246 ± .085 (.305)	11.292 ± .079 (.285)
Friday Harbor	1 yr.	16.593 ± .090 (.752)	16.720 ± .057 (.482)	25.242 ± .074 (.584)	17.964 ± .054 (.422)	11.266 ± .030 (.233)
Deadman's Bay	1 yr.	16.874 ± .060 (.648)	16.913 ± .035 (.377)	25.660 ± .051 (.550)	18.215 ± .038 (.410)	11.177 ± .026 (.287)
Chinook Pass	Field	17.127 ± .236 (.784)	16.882 ± .183 (.606)	25.573 ± .225 (.747)	18.118 ± .175 (.582)	11.082 ± .100 (.333)
Guemes Island	1 yr.	17.385 ± .072 (.611)	17.204 ± .038 (.325)	26.413 ± .061 (.514)	18.507 ± .041 (.349)	11.415 ± .021 (.181)
Longmire	Field	17.145 ± .190 (.631)	17.136 ± .150 (.499)	25.470 ± .230 (.726)	18.009 ± .161 (.536)	11.164 ± .052 (.173)
Longmire	2 yr.	17.777 ± .121 (.715)	17.371 ± .075 (.437)	26.059 ± .080 (.467)	18.260 ± .050 (.297)	11.326 ± .032 (.191)
Oyster Bay	1 yr.	15.906 ± .069 (.653)	15.603 ± .041 (.392)	24.233 ± .062 (.588)	17.303 ± .044 (.421)	10.607 ± .030 (.291)
Paradise Park	2 yr.	17.117 ± .104 (.256)	17.250 ± .145 (.355)	26.467 ± .172 (.422)	18.383 ± .106 (.261)	11.083 ± .085 (.209)
Paradise Park	Field	17.700 ± .270 (.540)	17.300 ± .141 (.282)		18.250 ± .216 (.432)	11.500 ± .023 (.047)
Port Angeles	Field	16.355 ± .162 (.725)	16.070 ± .160 (.716)	24.500 ± .158 (.707)	17.350 ± .096 (.428)	10.885 ± .068 (.302)
Silver Lake	1 yr.	15.639 ± .081 (.666)	15.851 ± .055 (.445)	24.444 ± .092 (.732)	17.252 ± .061 (.496)	10.561 ± .042 (.274)
Silver Lake	2 yr.	16.128 ± .072 (.509)	16.192 ± .065 (.462)	24.814 ± .079 (.555)	17.367 ± .055 (.395)	10.675 ± .030 (.214)
Hood River	Field	16.700 ± .163 (.671)	16.067 ± .102 (.432)	24.589 ± .171 (.724)	17.633 ± .116 (.494)	11.050 ± .060 (.255)
Hood River	1 yr.	16.073 ± .081 (.717)	16.364 ± .045 (.399)	26.145 ± .116 (1.040)	17.769 ± .057 (.513)	10.756 ± .029 (.261)

TABLE IV

PELAGE COLOR OF *Peromyscus maniculatus* FROM WESTERN WASHINGTON AND ADJACENT OREGON

Mean tint-photometer readings, standard errors, and standard deviations (in parentheses), both sexes, in per cent.

Stock	Class	Dorsal Stripe		
		Red	Green	Blue-violet
Airport	Field	3.87 ± .12 (0.46)	2.93 ± .10 (0.38)	2.27 ± .12 (0.45)
Airport	1 yr.	4.83 ± .10 (0.63)	3.38 ± .11 (0.73)	2.40 ± .10 (0.66)
McKenna	1 yr.	3.68 ± .09 (0.73)	2.59 ± .08 (0.63)	1.86 ± .07 (0.52)
Shaw Island	1 yr.	3.60 ± .09 (0.85)	2.22 ± .06 (0.58)	1.68 ± .06 (0.58)
Shaw Island	2 yr.	3.20 ± .12 (0.45)	2.13 ± .11 (0.41)	1.60 ± .12 (0.48)
Steilacoom	1 yr.	4.18 ± .08 (0.63)	3.08 ± .08 (0.62)	2.44 ± .06 (0.49)
Steilacoom	2 yr.	3.75 ± .08 (0.67)	2.76 ± .08 (0.62)	2.16 ± .06 (0.52)
Bingen	1 yr.	5.53 ± .12 (1.22)	4.17 ± .10 (1.00)	3.23 ± .08 (0.82)
Dalles	1 yr.	6.91 ± .12 (1.18)	5.32 ± .12 (0.82)	4.03 ± .07 (0.75)
Dalles	2 yr.	7.19 ± .17 (0.97)	5.60 ± .11 (0.64)	4.34 ± .11 (0.66)
Deadman's Bay	1 yr.	4.32 ± .06 (0.67)	3.14 ± .05 (0.50)	2.31 ± .05 (0.50)
Friday Harbor	Field	4.87 ± .18 (0.70)	3.53 ± .13 (0.49)	2.73 ± .18 (0.68)
Friday Harbor	1 yr.	5.04 ± .08 (0.66)	3.76 ± .06 (0.56)	2.89 ± .06 (0.55)
Chinook Pass	Field	4.82 ± .34 (1.14)	3.36 ± .24 (0.78)	2.73 ± .23 (0.75)
Guemes Island	1 yr.	4.39 ± .06 (0.52)	3.25 ± .06 (0.48)	2.45 ± .06 (0.50)
Longmire	Field	4.82 ± .21 (0.70)	3.27 ± .14 (0.46)	2.46 ± .15 (0.50)
Longmire	2 yr.	4.83 ± .13 (0.76)	3.69 ± .10 (0.62)	2.83 ± .09 (0.52)
Oyster Bay	1 yr.	4.19 ± .11 (0.99)	3.15 ± .08 (0.73)	2.69 ± .07 (0.67)
Paradise Park	2 yr.	5.50 ± .16 (0.40)	3.83 ± .26 (0.63)	3.17 ± .20 (0.49)
Paradise Park	Field	5.40 ± .22 (0.50)	3.80 ± .18 (0.40)	3.00 ± .00 (0.00)
Port Angeles	Field	5.00 ± .16 (0.77)	3.52 ± .16 (0.78)	2.57 ± .12 (0.58)
Silver Lake	1 yr.	4.33 ± .09 (0.74)	3.10 ± .07 (0.58)	2.52 ± .06 (0.53)
Silver Lake	2 yr.	4.82 ± .13 (0.94)	3.43 ± .11 (0.78)	2.82 ± .11 (0.81)
Hood River	Field	6.06 ± .29 (1.25)	4.11 ± .20 (0.86)	3.22 ± .13 (0.57)
Hood River	1 yr.	5.93 ± .11 (1.02)	4.02 ± .08 (0.74)	3.04 ± .07 (0.62)

Stock	Class	Side Stripe		
		Red	Green	Blue-violet
Airport	Field	10.73 ± .31 (1.19)	7.93 ± .30 (1.14)	6.00 ± .15 (0.59)
Airport	1 yr.	11.71 ± .26 (1.68)	7.86 ± .18 (1.25)	5.14 ± .21 (1.37)
McKenna	1 yr.	8.71 ± .17 (1.39)	6.08 ± .15 (1.22)	4.43 ± .13 (1.02)
Shaw Island	1 yr.	8.16 ± .16 (1.47)	5.44 ± .12 (1.14)	3.84 ± .10 (0.92)
Shaw Island	2 yr.	8.33 ± .27 (1.05)	5.67 ± .30 (1.15)	3.73 ± .22 (0.83)
Steilacoom	1 yr.	9.46 ± .15 (1.18)	6.90 ± .13 (0.98)	5.26 ± .11 (0.90)
Steilacoom	2 yr.	10.37 ± .13 (1.08)	7.56 ± .11 (0.95)	5.66 ± .11 (0.87)
Bingen	1 yr.	12.81 ± .20 (2.08)	9.20 ± .15 (1.59)	7.01 ± .13 (1.34)
Dalles	1 yr.	15.87 ± .19 (1.86)	11.56 ± .14 (1.41)	8.59 ± .11 (1.14)
Dalles	2 yr.	16.03 ± .29 (1.66)	11.84 ± .21 (1.20)	8.69 ± .21 (1.18)
Deadman's Bay	1 yr.	10.68 ± .12 (1.28)	7.62 ± .10 (1.06)	5.38 ± .08 (0.86)
Friday Harbor	Field	12.80 ± .38 (1.49)	9.00 ± .29 (1.13)	6.40 ± .17 (0.65)
Friday Harbor	1 yr.	12.55 ± .13 (1.13)	9.17 ± .11 (0.94)	6.69 ± .09 (0.78)
Chinook Pass	Field	12.27 ± .62 (2.06)	8.36 ± .47 (1.56)	5.55 ± .45 (1.49)
Guemes Island	1 yr.	10.30 ± .13 (1.13)	7.37 ± .10 (0.83)	5.30 ± .10 (0.85)
Longmire	Field	12.91 ± .48 (1.60)	8.64 ± .41 (1.38)	6.00 ± .42 (1.30)
Longmire	2 yr.	12.60 ± .27 (1.57)	8.77 ± .22 (1.29)	6.34 ± .17 (1.00)
Oyster Bay	1 yr.	9.52 ± .18 (1.71)	6.99 ± .18 (1.63)	5.47 ± .15 (1.35)
Paradise Park	2 yr.	11.66 ± .89 (2.19)	8.33 ± .55 (1.36)	5.66 ± .45 (1.10)
Paradise Park	Field	11.20 ± .49 (1.09)	7.60 ± .32 (0.71)	5.20 ± .22 (0.50)
Port Angeles	Field	11.87 ± .25 (1.20)	8.35 ± .20 (0.94)	6.00 ± .17 (0.83)
Silver Lake	1 yr.	10.61 ± .20 (1.64)	7.33 ± .15 (1.24)	5.51 ± .11 (0.88)
Silver Lake	2 yr.	10.98 ± .17 (1.19)	7.65 ± .19 (1.35)	5.65 ± .15 (1.10)
Hood River	Field	13.11 ± .49 (2.08)	9.00 ± .33 (1.41)	6.61 ± .27 (1.13)
Hood River	1 yr.	13.27 ± .18 (1.66)	9.11 ± .14 (1.26)	6.61 ± .12 (1.06)

separated by any apparent barrier may differ considerably in their body and skeletal dimensions and in their pelage color. Due allowance for this local variability must be made in any study of geographic variation in these mice.

RELATIONS BETWEEN *austerus* AND *oreas*

The two subspecies *Peromyscus maniculatus oreas* and *P. m. austerus* were reported by Osgood (1909), to occur together in parts of the Puget Sound area of western Washington, as has been pointed out earlier in this report. The two subspecies are both reported from Aberdeen, Grays Harbor County; from Mount Vernon, Skagit County; from Tenino, Thurston County; and from four localities on the Olympic Peninsula, Boulder Creek, Boulder Lake, Happy Lake, and North Fork Skykomish River. In the collections of the Museum of Zoology, University of Michigan, are specimens referable to both *austerus* and *oreas* from Lake Cushman, Mason County (Dice, 1932*b*: 47), and from Alpha, Lewis County. Other museums undoubtedly have additional records of the occurrence together of these two different types of mice, but it has not seemed necessary to examine other museum specimens.

The most important difference between these two races of deermice is that *oreas* has a much longer tail than has *austerus*. Osgood (1909: 260) listed no specimen of *oreas* with a tail shorter than 105 mm. and no specimen of *austerus* with a tail longer than 96 mm. The other measurements of *oreas* also average larger than those of *austerus*. The skulls of the two races differ in certain of their proportions. No difference in pelage color between the two forms was noted by Osgood.

In comparing critically the stocks of mice from the Puget Sound region, I omit for the moment those from the islands in the Sound and those from the banks of the Columbia River. There remain then for comparison the five stocks from Airport, McKenna, Oyster Bay, Silver Lake, and Steilacoom, taken in the lowlands around the southern end of Puget Sound; the two stocks, Longmire and Paradise Park, taken on Mount Rainier; the one stock from the Cascade Mountains, taken at Chinook Pass; and the one stock from the lowlands on the Olympic Peninsula, taken near Port Angeles.

Among the stocks of mice here being compared, those with the longest average length of tail come from Longmire and Paradise Park in Mount Rainier National Park. Unfortunately, neither of these stocks is represented by the one-year age class and the Paradise Park stock is made up of only a few individuals. Nevertheless, the tail length in these stocks is so much greater than in any other stock here described (Fig. 1) and agrees so well with the published descriptions of *oreas* that one may consider both stocks to represent that subspecies.

The type locality of the subspecies *austerus* is Old Fort Steilacoom (Osgood, 1909), and our stock from Steilacoom may be assumed to be typical. The Steilacoom mice of the two-year age class average significantly smaller than do two-year-old specimens of *oreas* from Longmire in all dimensions of the body and skeleton. The difference is particularly great in tail length, being 28.54 ± .92 mm.

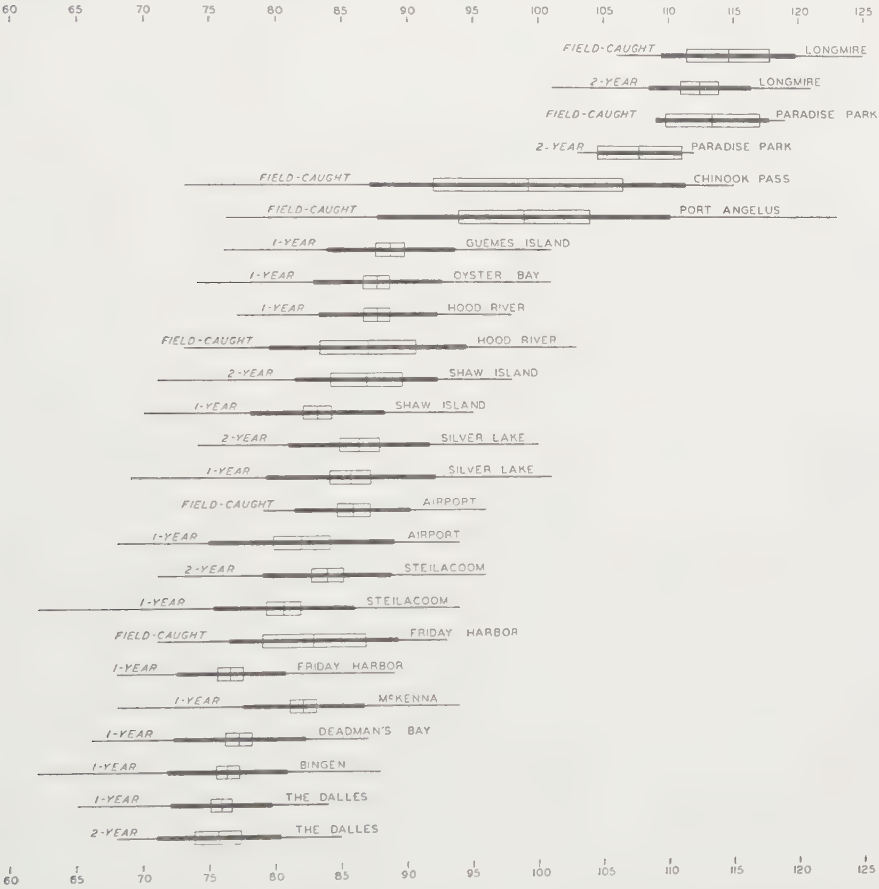


FIG. 1.—Graph of tail lengths of the stocks of *Peromyscus maniculatus* from western Washington and adjacent Oregon, drawn according to the method of Dice and Leraas (1936) and of Hubbs and Perlmutter (1942). The range in this measurement for each stock is indicated by the length of the light line; the position of the mean is shown by a crossbar; the open rectangle marks off two times the standard error on each side of the mean; and the heavy line extends for one standard ~~error~~ deviation on each side of the mean.

I must also refer the laboratory-bred stocks from Airport, McKenna, Oyster Bay, and Silver Lake to *austerus* on the basis of their measurements. All of these mice are smaller in their dimensions than is the Mount Rainier *oreas.* Precise comparisons with *oreas,* however, are not possible except for the Silver Lake stock, which is the only one represented by the two-year age class. The tails of the Silver Lake mice average only slightly longer than those of the Steilacoom mice and are much shorter than those of the Longmire mice, indicating a relationship to *austerus.* In their other measurements also the Silver Lake mice together with the other stocks of this lowland group fit properly into *austerus* when comparison is made of the one-year age classes.

The Airport stock averages significantly the smallest of this group of five *austerus* stocks in body length, length of mandible, condylo-premaxillary skull length, and condylo-zygomatic distance, when the one-year age classes are compared. In life the Airport mice appeared smaller and more slender than the others of the group, but their differences from the other *austerus* are not sufficient to justify their exclusion from the subspecies.

The wild deermouse population living at Oyster Bay evidently is made up of a mixture of *oreas* and of *austerus.* Two specimens of adult deer-mice prepared in the field at that locality by Dr. Leraas have tail lengths of 120 and 121 mm., respectively, and therefore are definitely *oreas.* A third specimen is too young to be identifiable. Of the mice sent alive to the laboratory for breeding only four were later measured and saved for specimens. Of these four specimens three have tail lengths of 108, 106, and 109 mm., respectively, and must be assigned to *oreas.* The other one has a tail length of only 83 mm. and is therefore *austerus.* Neither of the three known field-caught *oreas* produced any offspring. The laboratory-bred offspring of the single field-caught *austerus* can all be assigned to *austerus.* All the other animals of this stock born in the laboratory are also assignable to *austerus,* though the tails of some measure above 90 mm. and one has a tail length of 101 mm. In none of the laboratory-bred sibships is there any indication of segregation into *oreas* and *austerus.* In other words, although the Oyster Bay field-caught mice included both *oreas* and *austerus,* the *oreas* presumably all failed to breed and all the mice born in the laboratory can be assigned to *austerus.* Owing to lack of attention to this stock during the war years, the mixed character of this population was not recognized until all the field-caught animals had died or had been disposed of.

Neither the stock from Port Angeles nor that from Chinook Pass produced any offspring in the laboratory. Both of these field-caught stocks exhibit very great variability in tail length. The coefficient of variation for tail length in the Port Angeles stock is 11.30 and in the Chinook Pass stocks it is 12.10. The next highest coefficients of variation in tail length among the stocks here described are in the Hood River field-caught class and in the Airport one-year class, which are, respectively, 8.61 and 8.48. None of the measurements except tail length in any of the stocks here described has greater coefficients of variation than those calculated by Clark (1941: 296–97) for stocks of various species and subspecies of *Peromyscus* from other parts of North America.

The range of variation in tail length among the nineteen individuals of the Port Angeles stock is from 76 to 125 mm. Among the eleven individuals of the Chinook Pass stock the tail length varies from 73 to 115 mm. This amount of variation overlaps that of both *austerus* and *oreas*. It is my opinion that both the Port Angeles and Chinook Pass stocks were composed of a mixture of subspecies. Some of the field-caught individuals in both these stocks have very long tails and can be identified with a high degree of certainty as *oreas*. Certain other individuals have very short tails and undoubtedly are *austerus* or some other short-tailed form. Numerous individuals in both stocks fall into an intermediate position and cannot be identified with certainty (Fig. 2).

It is probable that this mixture of subspecies in the field-caught classes was a contributing factor in the failure of both the Port Angeles and Chinook Pass stocks to breed in the laboratory. At least some of the attempted matings in each stock must have involved crosses between the two forms.

In pelage color there seems to be no consistent difference between these stocks of *oreas* and of *austerus* (Fig. 3), which confirms the conclusions of Osgood. It is true that for certain color readings there are significant differences between the subspecies. Thus, for the readings of side-stripe red of the respective two-year age classes the Longmire stock exceeds the Silver Lake stock by 1.62 ± .31 units. This, however, is not a very large difference, and most of the color comparisons between the subspecies show no significant differences.

In attempting to explain the paradox of the occurrence together at certain localities in the Puget Sound area of a mixture of two subspecies, one must first consider the possibility that there may be a confusion in age classes, with the younger individuals being assigned to *austerus* and the older, and therefore longer-tailed, individuals in the same population being assigned to *oreas*. The amount of growth of these mice between the ages of fifty-two and 104 weeks, however, has been shown above to be not very great. In the Steilacoom stock, for example, the two-year-old mice exceed the one-year mice by 3.30 ± .90 mm. in tail length. This is a statistically significant difference, but the tails of the two-year-old Steilacoom mice are still much shorter than those characteristic of individuals of *oreas*. In the Silver Lake stock the differences in tail length between the one-year-old and two-year-old mice is only 0.69 ± 1.07 mm. It may be doubted that in nature many mice reach an age of two years, and therefore ages older than two years need not be considered.

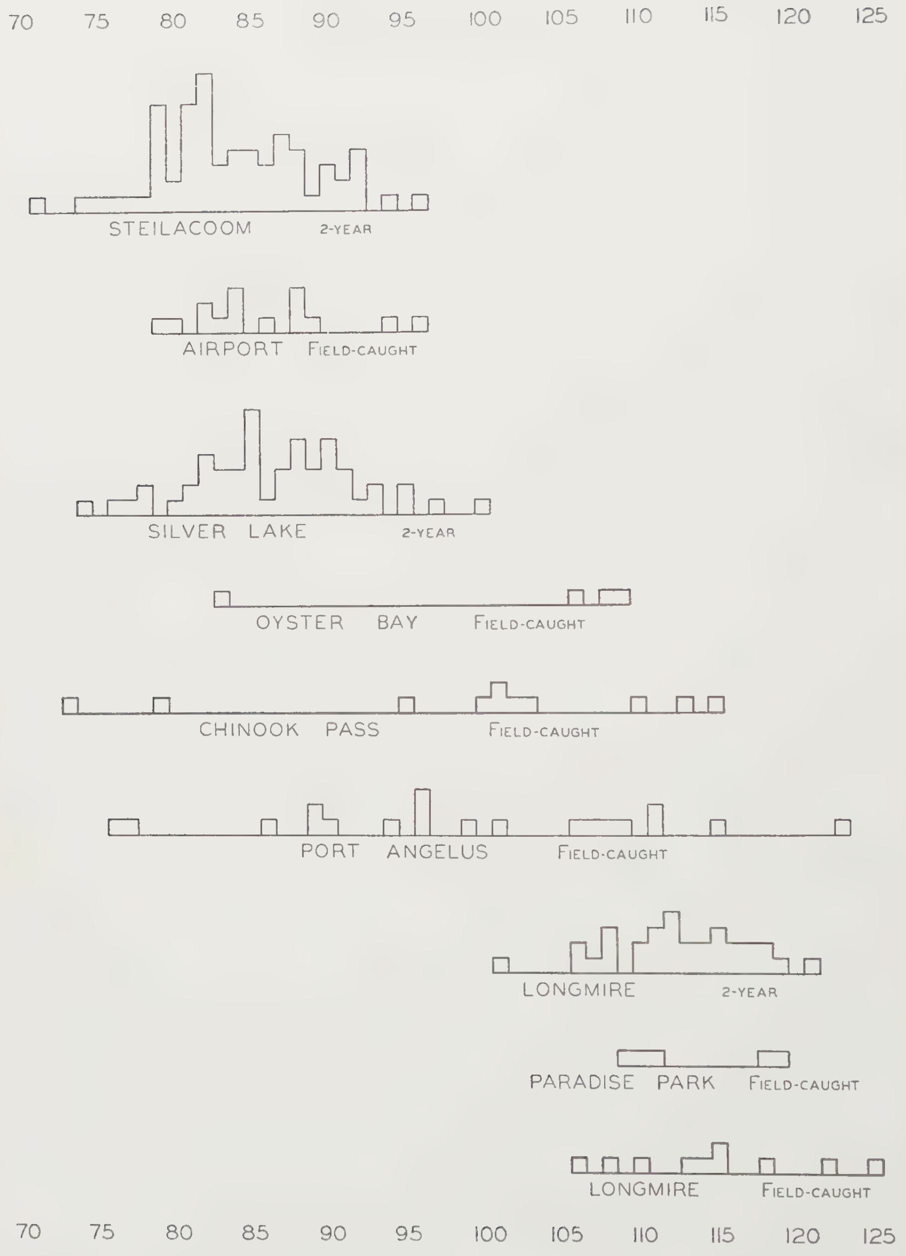


FIG. 2.—Frequency polygons for tail length of certain stocks of *Peromyscus maniculatus* from western Washington. Note that there is no overlapping in the measurements of the stocks of *oreas* from Longmire and Paradise Park and those of *austerus* from Steilacoom, Airport, and Silver Lake, but that each of the field-caught stocks from Oyster Bay, Chinook Pass, and Port Angeles is composed of a mixture of the two forms.

The occurrence of these two subspecies over the same geographic area is certainly not due to a confusion between age classes, with the younger, shorter-tailed mice being referred to *austerus* and the older, longer-tailed ones to *oreas*. The average differences in tail length between the one-year and two-year age classes are too little to cause any such confusion, except perhaps rarely for intermediate individuals. Furthermore, many lowland specimens in museums which obviously are old, as shown by tooth wear and by skull-suture closure, are not exceptionally long-tailed and must be assigned to *austerus*. Age differences cannot explain the presumed overlap in range between *austerus* and *oreas*.

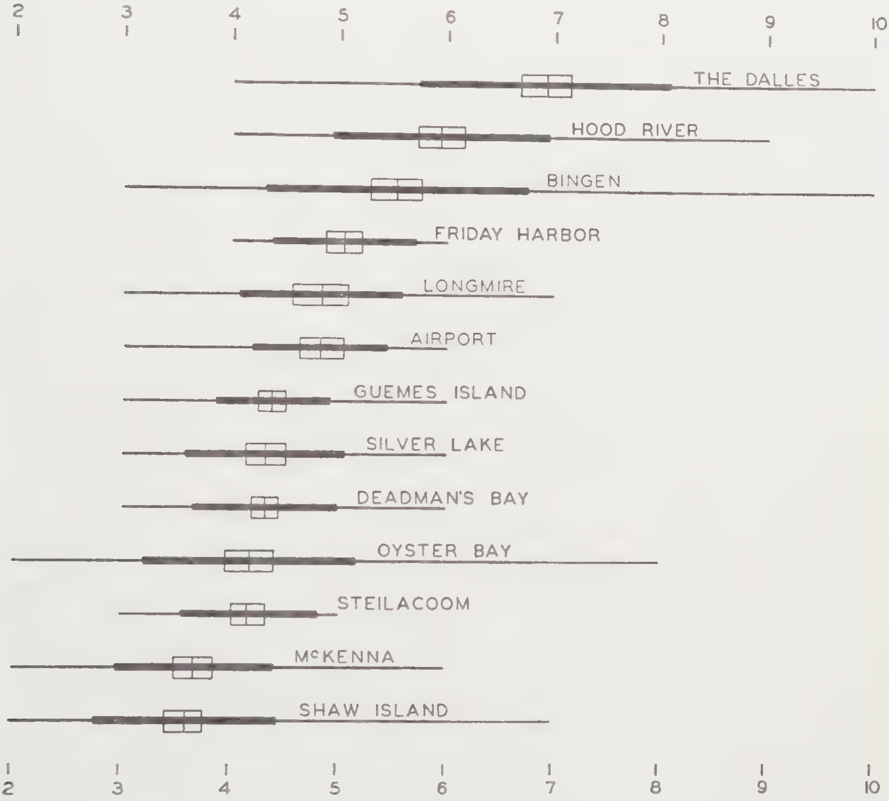


FIG. 3.—Graph of tint-photometer readings for dorsal-stripe red for certain stocks from western Washington and adjacent Oregon, drawn according to the method used in Figure 1. All are one-year laboratory-bred classes, except Longmire, which is the two-year class.

Another hypothesis that possibly might explain the occurrence in the same region of two distinct subspecies postulates the alternating occurrence in the Puget Sound region of two distinct types of local habitats, each the home of one or the other of the two races. It would then have to be further assumed that in a few localities, perhaps intermediate in type of habitat, both races could occur together.

Two alternating types of habitat actually do occur in parts of the lowlands of western Washington. Although most of the region is covered by coniferous forest, prairies also occur. According to Piper (1906: 42) these prairies are due to the local occurrence of gravelly soils. Prairies are most numerous from Tacoma south to the Columbia River, but they also are present near Vancouver and on some of the islands in Puget Sound. The tips of many of the points projecting into Puget Sound have gravelly soil, accompanied by the characteristic prairie flora and fauna (Piper, 1906: 22). I am informed by Earl J. Larrison (personal communication) that fires set by the Indians in the early days undoubtedly aided in preventing these prairies from being submerged by the forest. Dalquest and Scheffer (1944) have pointed out that the prairies south of Tacoma are now being rapidly invaded by forest.

The vegetation of the prairies is composed mostly of grasses and other herbs. A few scattered oaks and Douglas firs may be present. Often the transition to the heavy coniferous forest at the border of the gravelly area is very sharp.

Both the Longmire and Chinook Pass stocks were trapped in heavily timbered habitats, whereas the Paradise Park stock was taken just below timberline in the subalpine belt on Mount Rainier. My own experience in trapping in various habitats on Mount Rainier and elsewhere in the Puget Sound area indicates that *oreas* is most abundant in dense mature forests on the mountain slopes. It has, however, a wide distribution in various types of mountain habitats, as Taylor (1922) has indicated. One may suspect that the long tail and large feet especially adapt it for a semi-arboreal life in its forest habitat, but these mice are by no means strictly arboreal, for I have taken them readily in traps set on the ground.

In the prairie region south of Tacoma lie the collecting localities of Airport, McKenna, Oyster Bay, Silver Lake, and Steilacoom. The stocks from these localities are all assigned to the subspecies *austerus*. One might, therefore, suspect that *austerus* is an inhabitant of these prairies and that *oreas* is an inhabitant of heavy conifer forests.

Unfortunately for the hypothesis of a habitat difference between *austerus* and *oreas*, the subspecies *austerus* does not seem to be an inhabitant of the Washington prairies. My own trapping experience indicates that *austerus* is much more numerous in forest than in open areas. Most of the specimens of *austerus* that I trapped at Silver Lake in 1940 were taken in fairly heavy second-growth forest and only a few were secured in a cleared field where bracken fern was growing among the stumps. H. J. Leraas wrote that the stocks from Airport, McKenna, Oyster Bay, and Steilacoom were all trapped in second-growth forest. The prairies which I examined between McKenna and Tacoma were all very dry and appeared so unsuited for *Peromyscus* that I did not even attempt to trap in that habitat.

The evidence at hand demonstrates that the subspecies *austerus,* like *oreas,* is an inhabitant of forests. There is no habitat difference between the two forms which could explain their occurrence together as distinct subspecies at some geographical localities in western Washington.

It is probable, nevertheless, that the smaller, shorter-tailed *austerus* may be somewhat better adapted that is *oreas* to some feature or features of the lowland habitat. The forests of the lowlands are in many places less dense than are those of the mountains. This sparseness of forest growth reaches its extreme in the prairies. Open spaces occur also along the beaches. Moreover, it is possible that the characters of *austerus* indicate a response to this somewhat open type of habitat, in the same way that prairie deermice usually have shorter tails and smaller feet than do forest forms (Dice, 1940: 215). No evidence is at hand, however, to prove that the small size and short tail of *austerus* actually is adapted to the sparseness of forest growth which is characteristic of the lowlands as contrasted with the more dense forests of the mountain slopes.

In general, *austerus* seems to be an inhabitant of the lowlands, but in the Olympic Peninsula it is reported from several mountain localities. Among these Happy Lake is said by Elliot (1899: 242) to have an elevation between 5,000 and 6,000 feet. On the other hand, *oreas* seems mostly to be an inhabitant of the mountains, but it is reported also from a number of localities in the lowlands. The difference in habitat between the two subspecies undoubtedly is an important factor in their distinctness, but I am not able at the present time to suggest how the animals select their habitats.

The possibility must next be considered whether *oreas* and *austerus* may not actually represent two different species, which in this region do not interbreed, but whose ranges here partly overlap. Such a hypothesis could best be tested by making matings between positively identified individuals of the two forms. No such matings are known to have been made. It will be recalled, however, that in the Oyster Bay stock there were examples of both forms and that so far as is known the *oreas* individuals failed to breed. This failure possibly may have been due to their being mated to *austerus* individuals instead of to other *oreas.*

Crosses were made between the Steilacoom mice and the Silver Lake mice, which at the time I assumed to represent *oreas.* The F_1 offspring proved to be fertile by producing an F_2 generation. I now, however, consider the Silver Lake stock to be referable to *austerus.* An F_2 generation has also been obtained in crosses between both the Steilacoom and Silver Lake stocks with the subspecies *blandus* from Tularosa, New Mexico.

Twelve matings between *oreas* from Longmire with *blandus* from Tularosa have all failed to produce any offspring, though all were continued for over seven months and all but two of them for more than eight months. There is, therefore, a strong indication of a lack of fertility between *oreas* and *blandus*, whereas *austerus* and *blandus* are fertile together. This suggests, but does not prove, that *oreas* and *austerus* matings may also be infertile.

The problem of the relationships between *austerus* and *oreas* still remains in some doubt. It is clear that *oreas* is in general a long-tailed mountain form living mostly in heavy forests and that *austerus* is a shorter-tailed lowland form living mostly in more open forests. Neither form is restricted either to the lowlands or to the mountains. In numerous localities both forms occur in the same local habitats, and there seems to be no ecological barrier between them. Age differences contribute to the difficulty of identifying certain individuals, but the most fully mature individuals are the ones most easily identifiable to subspecies. Both forms vary a normal amount in their measurements, and there is undoubtedly considerable overlapping in measurements between the two forms.

The most plausible hypothesis for the occurrence of these two distinct forms together in certain localities with no evident intergradation is that there is some kind of fertility barrier to their interbreeding. When mated with *blandus* from New Mexico, *austerus* has proved to be fully fertile, but matings of *oreas* with *blandus* have been unproductive. It therefore seems likely that *oreas* and *austerus* do not produce hybrid offspring. Proof of this hypothesis, however, must await further breeding tests between individuals definitely known to be *oreas* with those definitely known to be *austerus.*

VARIATION AMONG THE ISLAND STOCKS

Four of the stocks of deermice whose variability is here described came from three islands in Puget Sound. From San Juan Island two of the stocks, Friday Harbor and Deadman's Bay, were obtained. The other two stocks were from Shaw and from Guemes islands. Shaw Island lies just a little to the northeast of San Juan. Guemes Island is still farther east. All of these islands are in the San Juan group. They lie just east and a little north of Victoria, Vancouver Island, British Columbia. The greatest distance between any two of the island collecting localities is about twenty-five miles.

Friday Harbor on San Juan Island is the type locality of the subspecies *hollisteri.* I therefore assume that the Friday Harbor stock is typical of this subspecies.

The Guemes Island mice of the one-year age class average significantly larger than those from the other island mice in all dimensions of the body and skeleton except foot length and ear length, in which they do not significantly exceed the Shaw Island and the Deadman's Bay mice. In tail length the Guemes Island mice exceed those from Shaw Island by 5.47 ± .79 mm., those from Deadman's Bay by 11.44 ± .74 mm., and those from Friday Harbor by 12.02 ± .74 mm. The differences from the other island stocks in other measurements are not as extreme. It may be said, therefore, that the Guemes Island stock is somewhat larger and distinctly longer tailed than are the other island stocks.

The Shaw Island mice significantly exceed both the Friday Harbor and Deadman's Bay mice in tail length and foot length. The Shaw Island mice also significantly exceed the Friday Harbor mice in ear length, but are significantly surpassed by that stock in bullar width of skull. The Deadman's Bay stock significantly exceeds the Shaw Island stock in length of mandible and condylo-premaxillary distance.

The two stocks from San Juan Island differ from one another in that the Deadman's Bay stock is significantly the larger in foot length, ear length, length of mandible, condylo-premaxillary skull length, and condylo-zygomatic distance. None of these differences is very great in amount. One of the greatest differences is in ear length, which amounts to 0.856 ± .100 mm.

The several island stocks differ more among themselves in pelage color than they do in dimensions. The Shaw Island stock is the darkest of all four stocks in every color comparison, as shown by its significantly lower tint-photometer readings. The Friday Harbor stock is the palest of these stocks and its tint-photometer readings average significantly higher than those of any other. The Guemes Island and Deadman's Bay stocks are intermediate in color readings. These two stocks do not differ significantly from each other in any color comparison. Some of the differences between the island stocks in pelage-color readings are of considerable amount. For example, the difference in tint-photometer readings of side-stripe red between the Friday Harbor and Shaw Island stocks amounts to 4.39 ± .20 units.

In view of the fact that all the islands here considered are close together and that local variations in measurements of considerable amount occur on the same island, all four island stocks are here tentatively assigned to the same subspecies, *hollisteri*. It is admitted, however, that there are important differences between the several stocks in dimensions and in pelage color.

No critical study of the effects of island isolation on the characters of the deermice can be made from the data at hand. Only single stocks are available from two of the islands; only two stocks are on hand from San Juan Island; and many islands in the group are not represented by any stock.

The deermice of the one-year age class from Guemes Island, Shaw Island, Friday Harbor, and Deadman's Bay all average significantly larger in all dimensions of the body and skeleton except tail length and ear length than do the five stocks from the mainland assigned to *austerus.* In tail length there is much variability among the stocks assumed to be *hollisteri* and also among those assumed to be *austerus,* with broad overlapping between the two subspecies. In ear length the Friday Harbor stock does not significantly exceed the Oyster Bay stock. In their other measurements all the *hollisteri* stocks exceed all the *austerus* stocks. I conclude that in general *hollisteri* averages larger than *austerus* in all dimensions except tail length.

In tint-photometer readings of pelage color the Shaw Island stock averages darkest of all the stocks of *hollisteri* and *austerus,* but in only half the color comparisons are its means significantly below those of *austerus* from McKenna. In its turn the McKenna stock averages significantly darker than all the other stocks except that from Shaw Island. One must conclude that there are considerable differences in pelage-color averages between the several stocks of both *hollisteri* and of *austerus,* but that no consistent difference in pelage color between the two subspecies is shown by the stocks here compared.

In order to compare my stocks of *hollisteri* with those of *oreas* I shall use mostly the two-year age class and the field-caught class, because no one-year class of *oreas* is at hand. The Longmire and Paradise Park stocks have significantly longer tails than those of any of the island stocks. The feet of the *oreas* stocks also average longer than those of *hollisteri,* but the standard errors of the differences are high and in some comparisons are not significant. In pelage-color readings there are greater differences between the several island stocks than there are between these and the stocks of *oreas* from Mount Rainier. I conclude that *oreas* differs from *hollisteri* mostly in its greater length of tail and of hind foot.

The Guemes Island stock rather closely approaches *oreas* in its dimensions, except for tail length. Comparison with *oreas* is difficult because I have only the one-year class from Guemes Island and only the two-year class from Longmire. The Guemes Island one-year mice exceed the Longmire two-year mice in body length, condylo-premaxillary skull length, condylo-zygomatic distance, and bullar width of skull. In tail length the Guemes Island mice average only 88.68 mm., which is far less than the mean for *oreas.* Although the Guemes Island mice are somewhat larger in some of their body dimensions than those of the other island stocks and thereby approach *oreas,* their tails are relatively short, and it seems best to refer them to *hollisteri* along with the other island stocks.

Because of the absence of comparable laboratory stocks from the islands farther north in British Columbia, including Vancouver Island, no comparisons of these stocks from the San Juan islands can be made with the other island races of *Peromyscus* described by various authors.

The climate of this island group is said by Earl J. Larrison (personal communication) to be much more arid than is general for the Puget Sound area. The average annual precipitation of the area is twenty to thirty inches, which is the lowest of any part of the Puget Sound region of Washington (*Yearbook,* U. S. Dept. Agric., 1941: 1179). The aridity is due to the position of these islands in the rain shadow of the Olympic Mountains. On the islands the forests are rather open and are much less dense than those on the western slopes of the Cascades. Guemes Island, however, lies on the eastward side of the island group, and it receives heavier precipitation and has a heavier stand of forest than either Shaw Island or San Juan Island. The relatively heavy pigmentation of the Shaw Island mice indicates that there is no even gradient of pelage color in these islands which might be correlated with amount of precipitation. Shaw Island lies between San Juan and Guemes islands, on both of which the deermice are paler than are those on Shaw Island.

EFFECTS OF THE CASCADE MOUNTAINS AND COLUMBIA RIVER BARRIERS

In the area under study the Cascade Mountains and the Columbia River constitute barriers to the distribution of many kinds of animals. It will be of interest to attempt an analysis of the influence of these barriers on the characters of the deermice living in the area.

The Cascade Mountains extend north and south across the whole width of the state of Washington. Many of the collecting localities for the stocks of mice here described lie west of the mountains, including those of Longmire and Paradise Park, which are on Mount Rainier.

The Chinook Pass locality lies in a valley in the Cascade Mountains, but on their eastern slope, where the climate is somewhat more arid than on the western side of the range. It has been pointed out in an earlier section of this report that the Chinook Pass animals seem to be a mixture of two forms, one with very long tails and referable to *orcas*, and the other with shorter tails. It is possible that these short-tailed individuals represent one of the shorter-tailed forms of *Peromyscus* which live in the arid interior east of the mountains. I have no stocks of mice available from the interior near by, and no critical evaluation can be made of the effects of the Cascade Mountains at this locality on the characters of the deermice.

The Columbia River cuts directly across the Cascade Mountains in a deep gorge. By traversing this gorge one may, in a few miles, pass from the heavy coniferous forests characteristic of the western slopes of these mountains to the arid grass and sagebrush of the interior (Lawrence, 1939). The collecting locality of Hood River lies on the south side of the river in the gorge of the Columbia in the transition area between forest and open country. The collecting locality for the Dalles stock lies thirty-five miles to the east of the Hood River locality on the same side of the river, just east of the gorge in arid grassland. The Bingen locality is north of the river about thirteen miles east of a point directly opposite the Hood River station. The habitat at Bingen is somewhat more arid than the one at Hood River, owing to its southern exposure, but some brush and trees are present so that it differs from the more open conditions at the Dalles station.

Any possible barrier to deermouse distribution which might be interposed by the Cascade Mountains is broken down through the Columbia Gorge. An individual animal, if one mouse could travel that far, could go directly by way of the gorge from the collecting locality at Hood River to the Dalles locality without encountering any barrier to his movements other than a few small streams and canyons, all of which he could easily cross. He would not even have to climb any mountains in making this journey, as may be seen from the railroad and motor highways both of which parallel the river through the gorge. The only serious barrier which such a mouse traveler might encounter would be the change in climate and in habitat type, for in going from Hood River to The Dalles he would pass from moderately heavy forest to arid grassland.

Comparing now the measurements of the three stocks of deermice from the shores of the Columbia River one finds that, in the one-year age class, the Hood River mice average larger than the Bingen and the Dalles mice. The Hood River means significantly exceed those of both the other stocks for tail length, foot length, condylo-premaxillary skull length, and condylo-zygomatic distance. Only in bullar width of skull does the stock from Bingen significantly exceed the Hood River stock. In ear length and femur length the Hood River and the Dalles mice do not differ significantly from one another, but both significantly exceed those from Bingen. In length of mandible the Hood River and Bingen mice do not differ significantly, but both exceed significantly the Dalles mice. There is no significant difference between any of the three stocks in body length.

The Bingen stock significantly exceeds the Dalles stock in foot length, length of mandible, skull length, and width of skull, but is exceeded significantly by the Dalles stock in ear length and femur length.

It may be concluded therefore, that the measurements of the Bingen and Dalles stocks do not differ from one another in any consistent manner, but that the Hood River stock averages larger in size than either of the other two. In tail length in particular the Hood River mice exceed the other two stocks by considerable amounts, the difference from the Bingen mice being 11.25 ± .65 mm. and from the Dalles mice 11.74 ± .61 mm.

In pelage color the Dalles mice are the palest of all the stocks here compared, including those from the Puget Sound region as well as those from the banks of the Columbia River. In every color comparison, both for the dorsal and side stripes, the Dalles stock has significantly higher tint-photometer readings than any other of these stocks. Some of these differences in color readings are moderately large. For example, in readings of dorsal-stripe red the Dalles mice exceed the Hood River mice by 0.98 ± .16 units and of side-stripe red by 2.60 ± .26 units. On the other hand, there is no significant difference in readings between the Hood River and the Bingen mice in any color comparison.

The mice of the *maniculatus* group living west of the Cascade Mountains in Oregon were assigned by Osgood to the subspecies *rubidus*. The stock from Hood River falls well within the range of variability of the stocks of this subspecies previously reported (Dice, 1941) from four localities in western Oregon. It will be noted that in comparison with the other Oregon stocks previously reported, the Hood River stock more closely resembles in tail length the stock from Eugene, which lies in a somewhat open interior valley, rather than the longer-tailed stocks from Tillamook, Coos Head, or Port Orford, all of which localities lie in the more densely forested belt along the coast. In pelage color the Hood River stock falls within the range of variation exhibited by the four stocks from western Oregon previously described and is in no way distinctive in color from those stocks. The Hood River stock must be assigned to the subspecies *rubidus*, although the collecting locality lies in a transition area toward the more arid conditions of the interior. The only important evidence of intergradation toward *gambelii* shown by the Hood River mice is their somewhat shorter tail as compared to most of the Oregon *rubidus*.

Compared to the five stocks of *austerus* described earlier in this report, the Hood River mice of the one-year age class average significantly larger in body length, foot length, length of mandible, condylo-premaxillary skull length, and condylo-zygomatic distance. In tail length they do not differ significantly from the Oyster Bay or Silver Lake mice, but significantly exceed the McKenna, Airport, and Steilacoom mice. In pelage color the Hood River stock averages paler than do any of the *austerus* stocks, the differences in tint-photometer readings being significant for every color comparison.

The mice of the Dalles stock must be assigned to the subspecies *gambelii*, which is paler and shorter tailed than is *rubidus*. In body and skeletal measurements the Dalles mice of the one-year age class fall within the range of variation of *gambelii* stocks previously described from Lyons Ferry South, Prescott, and Wallula in Washington, and from Los Banos and La Jolla in California (Dice, 1939 and 1941). Only in ear length do the Dalles mice significantly exceed all the previously described stocks of *gambelii*, the nearest in ear length being the stock from La Jolla, California, which averages 0.781 ± .081 mm. shorter. In pelage color the mice from the Dalles stock are somewhat darker than most of the stocks of *gambelii* previously described. The stock from The Dalles significantly exceeds the stock from Prescott, Washington, however, only in tint-photometer readings for dorsal-stripe red, the difference being 1.07 ± .27 units. The colors of the Dalles mice, which are darker than those of most of the stocks of *gambelii* previously described, may be assumed to represent intergradation toward *rubidus*.

The Bingen mice of the one-year age class exceed somewhat in body measurements most of the stocks of *gambelii* previously described. The only measurements in which these differences are significant are foot length, length of mandible, and condylo-premaxillary skull length. In pelage color the Bingen stock averages darker than does any stock of *gambelii* of which measurements have been made. As previously pointed out, the tint-photometer readings of the Bingen mice are close to those of the Hood River mice.

Compared to the stocks of *austerus* from Puget Sound, described in an earlier section of this report, the Bingen mice have significantly longer bodies, mandibles, and skulls, and greater skull widths, but have significantly shorter tails. The Bingen mice also are paler than *austerus* in pelage color, their tint-photometer readings being significantly greater in every color comparison, both of the dorsal and side stripes, than any of the *austerus* stocks. The characters of the Bingen mice are evidently intermediate between *austerus* and *gambelii*.

From the comparisons made earlier of the two stocks of mice from the south side of the Columbia River it is evident that the Hood River and Dalles mice differ strikingly from each other both in body dimensions and in pelage color. This is true in spite of the fact that these localities are only thirty-five miles apart on the same side of the river. That the differences beween these two stocks are not due to random local variation also seems certain. The characters of the Hood River mice are similar to those of the mice which occupy the forests of western Oregon, while those of the Dalles mice are similar to those of the deermice from the arid interior of the state. In the short space of thirty-five miles the characters of these mice change, in agreement with the change in the characters of their habitats, from body dimensions and pelage colors characteristic of heavy forest to those which are characteristic of arid grassland and sagebrush.

The interior region of Oregon and Washington, east of the Cascades, lies in the rain shadow of these mountains. It is the presence of the mountains, therefore, which produces the aridity of the habitats of eastern Oregon and eastern Washington. The characters of the deermice on each side of the mountains are correlated with the climate, vegetation, and soil color of their respective habitats. In the gorge of the Columbia River, where there is no physical barrier to the movements of the mice, they nevertheless change their characters in accord with the change there in the characters of the habitat. It is evident, therefore, that the Cascade Mountains do not form a physical barrier to the distribution of these subspecies. Indirectly, the mountains, through their effect on the climate, do control the distribution and the characters of the several subspecies of deermice living in the region. This conclusion is entirely in accord with the deductions of biogeographers in general.

The Columbia River in the area of this study is wide and has in most places considerable current. The channel is not in process of any important shifting. Under present conditions the transfer of any part of a riparian habitat together with its deermouse population from one side of the river to the other could hardly occur. The river here does not freeze over in winter. The successful crossing by a swimming mouse of this wide and generally turbulent river must be an extremely rare occurrence. A crossing of the river on a floating log or raft of any kind must also be infrequent. I conclude, therefore, that the interchange of genes between the deermouse populations which live north and south of the Columbia River, respectively, must be so infrequent as to be negligible.

The effect of the physical barrier of the Columbia River on the characters of the deermice is difficult to evaluate, because of the scanty number of stocks available from the two sides of the river. It has already been shown that the Bingen stock, from the north side of the river, is similar to the Hood River stock in pelage color and is generally similar to the Dalles stock in body and skeletal dimensions. The Hood River and Dalles stocks from the same side of the river differ more from each other than either does from the Bingen stock. With the small amount of evidence at hand it cannot be demonstrated that the barrier of the river has had no effect in producing divergent characters in the mice on the opposite sides of the stream. Nevertheless, the differences between the Bingen stock and the Hood River and Dalles stocks, respectively, from the other side of the river may possibly be explained as owing to the character of the habitat at the Bingen locality, which is somewhat intermediate between forest and grassland. Habitat seems to be more important here in determining the characters of these deermice than does the presence of the barrier of the Columbia River.

The similarity in characters between the stocks of mice on the two sides of the Columbia River, does not necessarily imply any close similarity in their hereditary factors. Similar characters of body dimensions and of pelage color could be produced by very different gene combinations. It is possible that the Columbia River, through its effect in preventing the interbreeding of the populations of these mice on the north and south banks, respectively, may actually have produced a difference in the frequencies of certain genes on the two sides of the river. The present evidence, unfortunately, does not bear directly on this problem, which could only be investigated through the identification of the genes responsible for the characters of the mice and then the measurement of their frequencies on the two sides of the river.

A study by Moody (1948) of the cellular antigens of the three stocks of *Peromyscus* from Hood River, Bingen, and The Dalles failed to uncover any clear evidence of differences between them which could be correlated with the effect of the river as a barrier to distribution. The differences between the antigens of the three stocks were mostly of a quantitative nature. The Bingen stock from north of the river did not exhibit any greater differences from the stocks originating south of the river than these two stocks did from each other. The evidence from the cellular antigens agrees with the evidence from the morphological characters in failing to uncover any significant effect of the river as a barrier to the dispersal of the hereditary factors of these mice. As previously pointed out, this evidence is of a negative sort, but does suggest that there is no important difference in hereditary factors between the mice on the two sides of the river.

SUMMARY

The variation is described of sixteen stocks of *Peromyscus maniculatus* from localities in western Washington and adjacent Oregon. The descriptions apply only to the laboratory-reared animals, which do not fully represent the wild ancestral populations.

A small amount of growth takes place in these mice between the ages of fifty-two and 104 weeks in all dimensions of the body except foot length, but there is no significant difference in pelage color between the one-year-old and two-year-old mice.

No conclusive evidence was found of a difference in body dimensions or in pelage color between the mice caught in the field and then kept for a year or more in the laboratory and those bred in the laboratory.

Many of the stocks which come from closely adjacent field stations vary locally, even where there are no evident barriers to the movements of the mice.

The subspecies *oreas,* which in western Washington inhabits chiefly the dense coniferous forests on the mountain slopes, is larger in its body dimensions and has a longer tail than *austerus,* which is mostly an inhabitant of the more open lowland forests. In a few situations the two forms occur together without intergradation. No ecological barrier separates the two forms. It is possible that the two forms do not interbreed, but this has not yet been demonstrated.

The mice occupying the islands of the San Juan group in Puget Sound are referred to the subspecies *hollisteri,* which averages larger than *austerus* in all body dimensions except tail length and which differs from *oreas* in having a shorter tail and smaller foot. There are important differences between some of the island stocks in certain of their dimensions and in pelage color.

In Oregon the deermice living in the forests on the western side of the Cascade Mountains belong to the dark, long-tailed race *rubidus,* whereas the mice living in the arid grasslands and sagebrush of the interior, immediately east of these mountains, belong to the subspecies *gambelii,* which is characterized by shorter tail and paler pelage. The Columbia River cuts through the Cascade Mountains in a deep gorge, so that through the gorge there is no physical barrier to the movements of the deermice. Nevertheless, there is no extensive mixing of deermouse characters in this situation. Mice from an open-forest situation within the gorge at Hood River are referable to *rubidus,* but those from The Dalles, thirty-five miles to the eastward and lying just east of the gorge in arid grassland, are referable to *gambelii.*

The Columbia River constitutes an important physical barrier to the movements of deermice. Nevertheless, a stock from Bingen in the Columbia Gorge on the north side of the river is more or less intermediate in characters between the stocks from Hood River and from The Dalles. This intermediate character corresponds to the intermediate character of the Bingen habitat, which is rather arid, though some trees and brush occur. The characters of the habitat seem therefore to be of more importance in controlling the characters of these mice than do the physical barriers to their distribution.

LITERATURE CITED

CLARK, FRANK H.

1941 Correlation and body proportions in mature mice of the genus Peromyscus. Genetics, 26: 283–300.

DALQUEST, WALTER W., and VICTOR B. SCHEFFER

1944 Distribution and variation in pocket gophers, *Thomomys talpoides,* in the State of Washington. Amer. Nat., 78: 308–33, 423–50, 8 figs.

DICE, LEE R.

1932*a* Variation in a geographic race of the deer-mouse, *Peromyscus maniculatus bairdii.* Occ. Papers Mus. Zool. Univ. Mich., 239: 1–26, 1 fig.

1932*b* Mammals collected by F. M. Gaige in 1919 at Lake Cushman and vicinity, Olympic Peninsula, Washington. Murrelet, 13: 47–49.

1939 Variation in the deer-mouse (*Peromyscus maniculatus*) in the Columbia Basin of southeastern Washington and adjacent Idaho and Oregon. Contrib. Lab. Vert. Biol. Univ. Mich., 12: 1–22, 1 map.

1940 Ecologic and genetic variability within species of Peromyscus. Amer. Nat., 74: 212–21.

1941 Variation in the deer-mouse, *Peromyscus maniculatus,* in parts of Oregon, California, and Baja California. Contrib. Lab. Vert. Biol. Univ. Mich., 18: 1–11, 1 map.

DICE, LEE R., and HAROLD J. LERAAS

1936 A graphic method for comparing several sets of measurements. Contrib. Lab. Vert. Biol. Univ. Mich., 3: 1–3, 1 fig.

ELLIOT, D. G.
1899 Catalogue of mammals from the Olympic Mountains, Washington, with descriptions of new species. Field Columbian Mus. Publ., Zool. Ser., 1: 241–76, 21 pls., unnumbered figs.

HUBBS, CARL L., and ALFRED PERLMUTTER
1942 Biometric comparison of several samples, with particular reference to racial investigations. Amer. Nat., 76: 582–92, 1 fig.

LAWRENCE, DONALD B.
1939 Some features of the vegetation of the Columbia River Gorge. Ecol. Monogr., 9: 217–57, 10 figs.

MOODY, PAUL A.
1948 Cellular antigens in three stocks of *Peromyscus maniculatus* from the Columbia River valley. Contrib. Lab. Vert. Biol. Univ. Mich., 39: 1–16, 1 map, 2 figs.

OSGOOD, WILFRED H.
1909 Revision of the mice of the American genus *Peromyscus.* U. S. Biol. Surv., N. Amer. Fauna, 28: 1–285, 8 pls., 12 figs.

PIPER, CHARLES V.
1906 Flora of the State of Washington. Contrib. U. S. Nat. Herb., 11: 1–637, 22 pls., 1 folding map.

TAYLOR, WALTER P.
1922 A distributional and ecological study of Mount Rainier, Washington. Ecology, 3: 214–36, 4 figs.

United States Department of Agriculture.
1941 Yearbook. Washington, D. C. P. 1179.

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